CLAIMS

What is claimed is:

1. An active noise control system for controlling noise produced by a noise source, said system comprising:

an acoustic sensor to sense a noise pattern and to produce a noise signal corresponding to the sensed noise pattern;

an estimator to produce a predicted noise signal by applying an estimation function to said noise signal; and

an acoustic transducer to produce a noise destructive pattern based on said predicted noise signal.

2. The system of claim 1, wherein said estimator is able to adapt one or more parameters of said estimation function based on a noise error at a predetermined location.

3. The system of claim 2, wherein said noise error comprises an anticipated destructive interference between said noise pattern and said noise destructive pattern at said predetermined location.

4. The system of claim 2 or 3 comprising an error-sensing microphone to sense said noise error at said predetermined location.

5. The system of claim 2 or 3 comprising an error evaluator to evaluate said noise error based on said noise signal and said predicted noise signal.

6. The system of claim 5, wherein said error evaluator comprises:

a speaker transfer function module to produce an estimation of said noise destructive pattern by applying a speaker transfer function to said predicted noise signal;

a modulation transfer function module to produce an estimation of said noise pattern at said predetermined location by applying a modulation transfer function to said noise signal; and

a subtractor to subtract the estimation of said noise destructive pattern from the estimation of said noise pattern.

7. The system of any one of claims 2-6, wherein said estimator is able to adapt said one or more parameters based on a predetermined criterion.

8. The system of any one of claim 7, wherein said estimator is able to reduce said error value by adapting said one or more parameters.

9. The system of claim 8, wherein said adaptive estimator is able to minimize said error value by adapting said one or more parameters.

10. The system of any one of claims 2-9, wherein said one or more parameters comprise at least one parameter selected from the group consisting of a center parameter, an effective radius parameter, and an intensity parameter.

11. The system of claim 10, wherein said estimator is able to adapt said center parameter based on the following equation:

$$c_k(n+1) = c_k(n) - \mu_c e(n) w_k \sum_{s=0}^{S-1} STF(s) f_k\left[n - s\left[\frac{1}{\upsilon_k}\sum_{i=0}^{L-1}\left(x(n-i) - c_k(i)\right)\right]\right.$$

wherein $c_k(n+1)$ denotes an adapted value of said center parameter, $c_k(n)$ denotes a current value of said center parameter, w_k denotes said intensity parameter, L denotes a predetermined number of samples of said noise

signal, STF denotes a predetermined speaker transfer function, S denotes a predetermined speaker transfer function frequency parameter, μ_c denotes a predetermined convergence parameter corresponding to said center parameter, v_k denotes said effective radius parameter, e(n) denotes said noise error, f_k denotes a predetermined function, and x(n) denotes an n-th sample of said noise signal.

12. The system of claim 10, wherein said estimator is able to adapt said effective radius parameter based on the following equation:

$$\upsilon_k(n+1) = \upsilon_k(n) - \mu_\upsilon e(n) w_k \sum_{s=0}^{S-1} STF(s) f_k[n-s] \frac{1}{(\upsilon_k)^2} \sum_{i=0}^{L-1} (x(n-i) - c_k(i))^2$$

wherein $v_k(n+1)$ denotes an adapted value of said effective radius parameter, $v_k(n)$ denotes a current value of said effective radius parameter, w_k denotes said intensity parameter, L denotes a predetermined number of samples of said noise signal, STF denotes a predetermined speaker transfer function, S denotes a predetermined speaker transfer function frequency parameter, μ_v denotes a predetermined convergence parameter corresponding to said effective radius parameter, c_k denotes said center parameter, e(n) denotes said noise error, f_k denotes a predetermined function, and x(n) denotes an n-th sample of said noise signal.

13. The system of claim 10, wherein said estimator is able to adapt said intensity parameter based on the following equation:

$$w_k(n+1) = w_k(n) - \mu_w e(n) \sum_{s=0}^{S-1} STF(s) f_k[n-s]$$

wherein $w_k(n+1)$ denotes an adapted value of said intensity parameter, $w_k(n)$ denotes a current value of said intensity parameter, w_k denotes said intensity parameter, L denotes a predetermined number of samples of said noise signal, STF denotes a predetermined speaker transfer function, S denotes a predetermined speaker transfer function frequency parameter, μ_w denotes a predetermined convergence parameter corresponding to said intensity parameter, f_k denotes a predetermined function, and x(n) denotes an n-th sample of said noise signal.

14. The system of any one of claims 1-13, wherein said estimation function comprises a non-linear estimation function.

15. The system of claim 14, wherein said non-linear function comprises a radial basis function.

16. The system of any one of claims 1-15, wherein said acoustic sensor comprises a microphone.

17. The system of any one of claims 1-16, wherein said acoustic transducer comprises a speaker.

18. An active noise control system for controlling a noise produced by a noise source, said system comprising:

a primary acoustic sensor to sense a noise pattern and to produce a corresponding primary noise signal;

at least one secondary acoustic sensor to sense a residual noise pattern and to produce at least one secondary noise signal corresponding to the residual noise pattern sensed by said at least one secondary microphone,

respectively, wherein said at least one secondary acoustic sensor is separated from said noise source by a distance larger than a distance between said primary acoustic sensor and said noise source; and

a controller to control an acoustic transducer to produce a noise destructive pattern based on said primary noise signal and said at least one secondary noise signal.

19. The system of claim 18, wherein said controller comprises:

a primary estimator to produce a predicted primary signal by applying a primary estimation function to said primary noise signal; and

at least one secondary estimator to produce at least one predicted secondary signal by applying at least one secondary estimation function to said at least one secondary noise signal, respectively.

20. The system of claim 19, wherein said primary estimator is able to iteratively adapt one or more parameters of said primary estimation function based on a noise error.

21. The system of claim 19 or claim 20, wherein said at least one secondary estimator is able to iteratively adapt one or more parameters of said at least one secondary estimation function, respectively, based on a noise error.

22. The system of any one of claims 19-21, wherein said controller is able to control said acoustic transducer based on a combination of said predicted primary signal and said at least one predicted secondary signal.

23. The system of claim 22, wherein said controller is able to control said acoustic transducer based on the sum of said predicted primary signal and said at least one predicted secondary signal. .

24. The system of any one of claims 20-23, wherein said controller comprises a noise error evaluator to evaluate said noise error.

25. The system of claim 24, wherein said noise error evaluator is able to evaluate said noise error based on said primary noise signal, said at least one secondary noise signal and said predicted primary signal.

26. The system of claim 25, wherein said noise error evaluator comprises:

a speaker transfer function module to produce an estimation of a primary part of said noise destructive pattern corresponding to said predicted primary signal by applying a speaker transfer function to said predicted primary signal;

a modulation transfer function module to produce an estimation of said noise pattern by applying a modulation transfer function to a combination of said primary noise signal and said at least one secondary noise signal; and

a subtractor to subtract the estimation of the primary part of said noise destructive pattern from the estimation of said noise pattern.

27. The system of any one of claims 24-26, wherein said controller comprises at least one residual noise evaluator to evaluate at least one residual noise.

28. The system of claim 27, wherein said at least one residual noise evaluator is able to evaluate said residual noise based on said noise error and said at least one predicted secondary signal, respectively.

29. The system of claim 28, wherein said residual error evaluator comprises:

a speaker transfer function module to produce an estimation of a secondary part of said noise destructive pattern corresponding to said predicted

secondary signal by applying a speaker transfer function to said predicted secondary signal;

a subtractor to subtract the estimation of the secondary part of said noise destructive pattern from said noise error.

30. The system of any one of claims 18-29, wherein at least one of said primary acoustic sensor and said at least one secondary acoustic sensor comprises a microphone.

31. The system of any one of claim 18-30, wherein said acoustic transducer comprises a speaker.